Besides these laboratories, there are rooms with windows and glass doors, all capable of being transformed, when necessary, into laboratories, for every room has its tube with sea-water. But as it is most likely that by-and-by extensive collections will be formed, to assist in working out a most accurate and detailed fauna of the Bay, or even of the Tuscan Sea, these rooms, especially a large one on the south side, will at first be left empty.

Downstairs there is another small apartment on the north side, destined for a botanical laboratory. It has one large and two smaller windows, thus allowing four microscopical tables to be furnished, three of which will be let, whilst the fourth belongs to the botanist of the station, who is to be engaged next winter. In the basement two series of store-tanks will be placed, into which all the animals will be put immediately after being caught by the fishing and dredging expeditions, which will be sent out every day, weather permitting.

The library of the station has received many valuable presents. Thus Prof. Allman, Mr. Darwin, Prof. Flower, Mr. Gosse, Prof. Huxley, Mr. Gwyn Jeffreys, Sir John Lubbock, and Prof. Owen, have promised or sent their biological works; and German publishers, such as Georg Reimer of Berlin, and Braumüller of Vienna, have joined Engelmann, Vieweg, and Fischer, in offering all their biological publications. A catalogue is being prepared, containing a complete list of the actual state of the station library.

By the kindness of Mr. Gwyn Jeffreys, dredges have been procured of the best pattern, such as that experienced zoologist recommended; boats have been built for special dredging purposes, and everything also is being prepared to render the station as efficient as possible.

We hope in our next article to give some information as to the relations, into which the new institute has entered with governments and learned bodies. Here we may still be allowed to point out, that since the foundation of the Naples station has been taken earnestly into hand, similar endeavours have been made both in Austria and France. In both countries the Government has been asked to establish Zoological Laboratories on the coast. We have still to wait the results of such demands.

Naples, Oct. 24 ANTON DOHRN

VESTIGES OF GLACIAL ACTION IN NORTH-EASTERN ANATOLIA

IN a paper dated some months back* I gave an abridged notice of some traces of ice-action, referable to the so-called epoch, in the central plateau of Asia-Minor. A journey undertaken this summer through the north-eastern districts of the peninsula has enabled me to observe several other phenomena of the same class, and to determine in some measure the extent and degree in which that prolonged depression of temperature affected this region.

My route traversed an extensive but rarely visited tract of country, that, namely, of the great Chorok, or Harpagus river-valley from Beyboort to Artween, and the mountain lands that extend beyond that valley east and north up to the frontier of Russian Georgia, returning by the Black Sea coast. The space thus explored extends from long. 40° to 44° E., and from lat. 40° to 42° N.

The valley of the Chorok river, for a distance of about 120 miles—that is, from the neighbourhood of Beyboort to that of the town of Artween—runs almost parallel with the sea-coast in an E.N.E. direction, and is separated from the basin of the Euxine by a lofty chain of mountains, the higher peaks of which reach an altitude of 11,000 feet above the sea-level, and even more. The whole long and narrow strip of land bears the name of Lazistan, or country of the Lazes, a Mingrelian tribe, mentioned by Strabo as tenanting the same region in his time. Near Artween, long. 42,° the valley turns sharp to the north, and finds its way through a narrow and precipitous cleft to the sea.

The southern side is determined by the highlands which form the watershed between the tributaries of the Black Sea and those of the Persian Gulf; but farther east the same range, deflecting somewhat to the north, unites with the prolongation of the Lazistan mountains, and acts as watershed not only to the already-mentioned streams, but also to those of the Caspian, which it separates from the two other fluvial systems. Farther on the Russo-Georgian frontier follows its eastern slope.

Returning to the Chorok valley—one might almost call it trench—I may as well notice that its height above sea-level at Beyboort is about 5,000 feet, and at Artween only 1,000 feet, whence the extreme rapidity of the river, suitably named the Harpagus, may be inferred. The geological character of the mountain chains on either side is extremely varied. Cretaceous and Jurassic strata have in both been extensively superimposed on the plutonic rocks that frequently pierce through and form the higher ranges; volcanic formations, less ordinary in the southern chain, are of frequent recurrence in the northern. Indeed the Lazistan mountains, where they dip into the sea, are almost wholly volcanic in structure. Large tracts of a metamorphic character also occur, but more on the northern than on the southern side.

Roads, in a European sense of the word, throughout all these districts, there are none; even a tolerable horse-track is only an occasional luxury. Hence my entire tour was performed partly on horseback at walking pace, partly on foot; so that I had full opportunity for the most leisurely observation. My route first followed the southern side of the Chorok valley for about seventy miles, then the northern for about fifty more, after which I traversed the eastern highlands to the Russian frontier, a distance of about 160 miles, then turned north till I reached the Black Sea coast, along which I returned.

And having now given these summary indications, which the nature of the country, scarcely ever visited by Europeans, and in general very little known, seemed to make necessary, I will now proceed to the account of the principal phenomena referable to the glacial period.

While travelling at an altitude varying from 3,000 to 7,600 feet according to the exigencies of the route along the southern side of the valley—that is, on the northern slope of the Euphrates watershed—I crossed three large moraines, two of them descending from the slopes of Charmeli Dagh, a lofty granite ridge, streaked with snow all through the year. Their lower extremity was at about 5,000 feet above sea-level, their upper origin attaining nearly 8,000 feet. The mountain sides here are Jurassic or limestone; but the broad streams of angular blocks that follow their depressions were almost exclusively granite of the same kind as that which forms the mountain wall above. Where, however, the general altitude of the chain does not exceed 7,000 feet, as is occasionally the case, no moraines are to be observed, though large angular boulders are not uncommon on the broad ledges. The upper mountain lines are invariably rounded, and, as it were, smoothed off; the sides marked with scooped depressions much too wide for their depth to be attributable to torrent action; low down in the valley the slopes terminate in rifted precipices.

That the epoch to which these moraines belong was posterior to that of the volcanic action which, though long since extinct at the surface, has left so many traces along the north-eastern coast of Asia-Minor, was rendered in one instance sufficiently evident by the constituents of a broad stone-ridge which I crossed near the highest point of the mountain chain, a little to the east of Erzeroom.

Here, at an elevation reaching to upwards of 7,000 feet, the ordinary Jurassic strata were interrupted by a volcanic outbreak of several miles in extent, like a huge patch of black lava and scoriæ extending far up the mountain side, where traces of a large crater were still observable. Above, to a height of full 9,000 feet, towered the granite peaks, and here, reaching down towards the valley, a wide moraine traversed the road. It was mainly composed of volcanic fragments, though mixed with blocks of granite; and must consequently have been formed at a time when the volcano had not only existed, but had also ceased its action.

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* See NATURE, vol. v. p. 444

To assure myself of the true character of the phenomenon, I quitted the path and rode up and along the stone-stream to a considerable distance, till in fact my horse could no longer make his footing sure; and I had fully convinced myself that the moraine was the result of glacial action alone, not of torrents or weather action referable to more recent times.

Not far on I had to traverse the pass called Keskeem Boughaz, or, the entrance of Keskeem; this latter being the name given to the district on either side of the lower Chorok valley. The road here reaches an altitude of 8,200 feet; yet is far overtopped by the granite range of Tortoom, even now streaked with perpetual snow, to the south. Here again I observed a large moraine, winding down from the upper ridge; while the first plateau of Keskeem, about 7,400 feet above sea-level, into which I next descended, was strewn capriciously with large granite boulders, many ten or more feet in diameter. Another volcanic tract succeeds, where the path winds along a valley hemmed in by gigantic cliffs of black lava, dashed with blood-red porphyritic stains. From this point my track followed a level too low to permit of expecting or of finding any further glacial traces in this region.

Summing up the observations made during this stage of my journey, I come to the conclusion that the ice-cap of the north-easterly Anatolian watershed, in post-pliocene times, must have reached downwards, on the northern side of the range at least, to about 7,000 feet above the present sea level; while some of the glaciers issuing from it descended to about 4,500 feet of the same measurement. In what degree the sea-level of the entire eastern portion of the peninsula has changed—it would seem since the epoch referred to—I shall speak further on.

Two phenomena only remain to be noticed; - one, the absence of all organic traces, whether marine or otherwise, in these rocks and strata; an absence which I have heard remarked on by the few natives capable of observing these things; another, the frequent presence, in the moraine or glacial belt, of scratched and striated rocks, especially granite.

Crossing the river, now at its shallowest in the summer season, but still containing, at a distance of a hundred miles from its mouth, as large a body of water as the Thames during high tide at Richmond bridge, my path led to Artween, the chief village-centre of these regions, along the north-western side of the valley; that is, along the inner slope of the coast range. These Lazistan mountains form a very lofty, but comparatively narrow ridge, of great steepness, and ill adapted to the formation of glaciers; and besides they must have been, even in the glacial epoch, exposed to the comparatively mild atmosphere of the great sea, now represented by the Black Sea and the Caspian only, but which then covered so large a portion of what is now Russia.

Here, however, I again found evident traces of the same cold period, but written in different characters. Not moraines indeed, nor the other analogous appearances indicated in the more inland district, but signs of alternating snows and thaws, of weather-change and water-action on a scale much vaster than is possible in the existing condition of climate, even were the most rigorous winter, such as now is, to be succeeded by the warmest summer. Wide and deep clefts, the work of torrents, yet flowing, but dwindled to comparative insignificance; great sweeps of shattered rock fragments down slopes inaccessible from their steepness, due to frosts of a severity unknown at this day, followed by corresponding thaw; and every mark of climatic disintegration, much beyond, though in kind similar to, that which these crags now undergo. And lastly the water level of the Chorok itself, judging by the eroded shelves and like indications left here and there in the cliffs along its shores, must have been from fifteen to twenty feet above its actual level; a circumstance which can scarcely be attributed to other causes than the melting of great supplies of ice and snow; since there is no reason whatever to suppose that any considerable diminution in the forest growth around has taken place from the earliest to the present times.

That there really was such a difference between the glacial conditions of the Lazistan, or coast mountains, and those of the inland watershed in the epoch alluded to, is in a measure confirmed by their actual state. For though the Lazistan peaks considerably surpass in height those of the southern chain, being some of them above 11,000 feet in elevation, whereas the others average from 9,000 to 10,000 only, yet snow lies all summer through on the latter, much more abundantly than on the former; while on the other hand the annual quantity of rain and snow that in the winter months of the year fails on the Lazistan mountains is at least the double of what is apportioned to the southern or Armenian chain. A depression of 15° to 20° centigrade in the average temperature of the year, would now to a certainty cover the latter with glaciers, while it would furrow the former with torrents of the first magnitude.

Leaving the Chorook valley, my road—or track, to speak more properly, for road in our sense of the word there was none—led north-east up to the great water-shed already often mentioned, and which here, turning northwards also, separates from each other not the Black Sea and Persian Gulf river systems only, but a third also, that of the Caspian. For about forty miles my journey, though passing through a district abounding in other geological phenomena of great interest, yet supplied me with none of the class to which these notes specially refer, for the reason that it lay wholly along valleys and through ravines often below 4,000 feet in sea elevation, and never exceeding that height. But at the Karanlik Dagh, or Mountain of Darkness, so called either from the black and dense fir forests that clothe its sides, or from the thick mists that hang for months along its middle slopes, and at a point as nearly as possible opposite the extreme north-eastern angle of the Black Sea, here about fifty miles distant in a direct line, I began at last the ascent of the main ridge, the backbone of the land. While slowly climbing the limestone ledges of the mountain, and at the height of 6,400 feet, I here once more found athwart my way a colossal moraine, formed of worn granite blocks and partly overgrown with forest, descending from an overtopping height, which I afterwards ascertained to be about 8,000 feet. But before we reached it I traversed an intervening ledge, 7,300 feet above the sea, composed of granite rocks, worn and marked with unequivocal ice action, though now wholly bare of snow. A valley divided this ridge from the highest of all, that called Penek, up which a difficult track, called the "Egri Yokoosh" or "crooked ascent"—and it well deserved its name—brought us at last, landing us on a cold, undulating granite plateau of 9,000 to 9,500 feet in elevation. Here and there its depressions were scooped out into deep little oval lakes, full all summer through of clear blue water, and looking the very memorials of vanished ice; while the gently sloping sides of the plateau itself were strewn with boulders of every size and shape, but all granite, seemingly brought there from the higher peaks of the Penek chain, about five miles off. Nor did these boulders cease to occur, sometimes in greater abundance, sometimes less, till we reached the great basin of Ardahan, near the sources of the Kur, or Cyrus river, here a slender stream, on its way to join the Araxes, and enter with it the Caspian Sea.

The height of the Ardahan plain is 6,500 feet; it is, but for a very gentle easterly slope, an absolute water-like level; the bottom of this lake basin, for such it certainly was, consists of deep alluvial soil, mixed with detritus and large boulders; the sides are all rounded and smoothed off in gentle slopes, and bear every mark of having been long ice-covered. They are of various altitudes, but all alike. I climbed one of the lateral plateaus, at the north-eastern corner of the plain, till I had reached 2,000 feet above the Kur stream; boulders everywhere.

These plateaus stretch east to the Russo-Georgian frontier, about twenty-five miles distant. They contain many notable lakes, some of which I visited; that called Childer, in particular, is about ten miles in extreme length by eight in breadth. Its surface is 6,700 feet above the sea, and it is encased in mounded hills, like those already described. The natives declare its depth to be unfathomable, and, somewhat inconsistently, affirm that a submerged city exists below. But a clever Beg, or Chief of the neighbourhood, a friend of mine, had the curiosity to sail across it in every direction, sounding the bottom, and assured me that its greatest depth, near the northern extremity, did not exceed twenty-two fathoms, while he added, laughing, that of the buried city his line had discovered for him no trace. Karzach lake, not far off, a square-shaped sheet of water about four miles in extent each way, seems to be stilll shallower; while Teh Lake, as it is called, close by which my road passed, is now a mere marsh, though of considerable dimensions. Like the other two it has left, however, on its banks the marks of having been once much deeper and wider than at present. The plateau on which these lakes are situated continues, with alternate elevations and depressions, but always bearing the features already described, for about thirty miles to the north, till, having reached its greatest altitude in Kel Dagh, a mountain about 11,000 feet high, it begins to descend step by step to the plains of Georgia and the Black Sea. From this point its whole character changes, rifts, abrupt precipices, and narrow gorges taking the place of the rounded undulating outlines it bore farther inland. Nor is any further trace of boulders or moraines to be seen, at least below an elevation of nearly 8,000 feet.

It is to be remarked that this entire range, like the central Anatolian watershed, is almost uniform in its geological composition; Jurassic on its lower slopes; granite above. One only exception here occurs, and that is along the deep and rapidly descending chasm through which the torrent Kur finds its way; a chasm traversing the plateau in its greater width, from the basin of Ardahan to the Russian frontier. Its sides, and the rock in its neighbourhood to, in some places, a considerable extent, are volcanic.

My return route, from the Russian frontier near the well-known river Phasis, now the Rion, to Trebizond, lay along the coast; thus affording me excellent opportunities for studying on the northern or sea-side the same Lazistan mountain-chain, which I had already, in some measure, examined on its mainland or inner slope. Rarely stratified, its formations are most often volcanic, or metamorphic, gneiss and shale, with granite above. But if the inner and sheltered side had shown, as I have already noticed, no direct trace of glacial action, still less could I expect to discover any such on the outer or sea slope. However this generalisation was interrupted by one remarkable exception.

High up in the Lazistan mountains, about half way between Trebizond and Batoom, is perched the almost inaccessible district of Hamshun, a highland region tenanted by a colony of wholly different origin from the Mingrelian population around them, namely Armenian, though now all professing, not over-zealously, the Mahometan system. How or when they came there, no record tells. This district I resolved to visit; and three days of such breakneck scramble as even Turkish mountain-tracks had never before afforded me, brought me into the very centre of Hamshun.

Here, at the modest height of 6,900 feet above the sea, I stood on a granite-strewn plateau, thinly green with grass, sheltered from the sea by a tolerably lofty series of peaks on the N.W.; and backed to the S.E. by the tremendous jagged cliffs, blackish granite dashed with white snow streaks, else naked in all their savageness, but known by the uncouth names of Onoot Dagh, Alti Parmak Dagh, Jamookh Dagh; and, towering over all in startling resemblance to the Alpine Matterhorn, only more fantastic if possible, in its precipitous isolation of peak, Verehembek Dagh, rising full 12,500 feet above the sea, from which it is visible at a distance of about a hundred miles; a natural and unmistakeable beacon to the sailor. The plateau itself was about forty miles in length; and irregular in breadth; its surface too mounded, and often jotted over with boulders. But just as my track led near under the base of Verehembek, at an altitude of 8,300 feet, it crossed a large broad moraine, descending from the higher slope, and having its base in a broad bare valley not far below; thus indicating that here too, at the highest and widest part of the Lazistan chain, perpetual ice had once existed in sufficient quantity to furnish at least one glacier. But, if warrantable conclusions can be drawn from a single instance, the limited ice-cap of the Hamshun highlands extended no farther down than 8,500 feet at most, perhaps 9,000; thus differing by a line of one to two thousand feet from the glacial covering of the inland range.

What correctness there may be in this as in my other conjectures, I, of course, cannot well estimate: but I have now recorded the chief phenomena of this nature noted by me in these regions; it is for those more versed in such matters than myself to read their meaning aright.

Of the volcanic phenomena in the Lazistan or coast-chain, I shall say nothing here; that subject requiring, from its very copiousness, to be treated apart. But there is one fact connected with it worth noticing, as a corollary to what I have written; though a mere notice is all that can be given it for the present. It is, the elevation or depression of the south-east of the Black Sea coast.

In a former paper I remember having remarked that, judging by the actual position of an old river bar, as also by the height of certain cavernous excavations in the neighbouring cliffs, I am inclined to think that the coast near Trebizond itself has been raised to an elevation of about twelve, perhaps fifteen feet in post-glacial times. Having now ridden along the entire shore up to the mouth of the Phasis, I remark that the traces of similar uprising during, certainly not earlier than, the same period, as written on cliffs now a considerable way inland, on estuaries evidently prolonged, and on crags, still as before, coming sheer down into the sea, but wave-marked higher up than the possibility of the most violent storm could now effect; all these would seem to indicate that the same rising has been continued along the entire easterly line of coast, though not to an equal degree; the greatest elevation appearing to have taken place exactly at the south-eastern angle of the Euxine, near Batoom, from which point east and north it would gradually have diminished. West of Trebizond again it distinctly,—if traces of the kind mentioned be not misleading,—diminishes; till at, and to some distance west of Cape Jason it not only ceases, but is exchanged for a depression of the coast several feet, eight or ten seemingly, below its former level. Farther west again a slight rise would appear to have taken place; but allowance must be made for the effects of currents, which are very strong all along the coast.

Trebizond, Oct. 3 W. GIFFORD PALGRAVE